

RAMAN SPECTROSCOPIC STUDY OF SYNTHESIZED Na-BEARING MAJORITIC GARNETS: CHARACTERIZATION OF TRANSITION ZONE GARNETS

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Majoritic garnets in diamond have been considered as the sample from mantle transition zone (e.g. MOORE & GURNEY, 1985). For non-destructive, in-situ Raman analysis, GILLET et al. (2002) systematically checked chemistry and Raman peak of various majoritic garnets in diamond. They treated majoritic component as number of excess-silica than 3.0 per formula unit. However, in the basaltic system, majorite garnets also have significant amounts of sodium and its substitution is coupled with Si and Ti as follows; $Na + Ti = Ca + Al$ (RINGWOOD & LOVERING, 1970), $Na + Si = Ca + Al$ (SOBOLEV & LABRENTAV, 1971; RINGWOOD & MAJOR, 1971) or $Na + Si = Mg + Al$ (GASPARIK, 1989). Each component in garnet is defined as follows; Mj (majorite) component = $((Si - 3) - Na) / 2 \geq 0$, NaSi ($Na_2MSi_3O_{12}$ where M = Ca, Mg, Fe²⁺) component = $(Na - T) / 2 \geq 0$, and NaTi component = $Ti / 2$. OKAMOTO & MARUYAMA (2004) conducted UHP experiments in the MORB + H₂O system (KNCFMATSH) at 10 - 19 GPa. They show that 1) Mj and NaTi component are constant and lower than 0.1 at T = 900 °C, and 2) NaSi component increases drastically above 15 GPa. In order to understand the relation between Raman spectra and chemistry of majoritic garnets, OKAMOTO & MARUYAMA (2004)' run charges were newly analyzed. Above 15 GPa, there is a characteristic sharp peak at 910 cm⁻¹ and broad shoulder between 800 and 900 cm⁻¹ as well as broad band near 960 cm⁻¹. GILLET et al. (2002) concluded that the former peak at 910 cm⁻¹ is the only reliable signature for the majoritic garnet (Si > 3) and the latter two broad peaks are diagnostic feature for Ti rich garnet (TiO₂ > 1 wt%) as well as peak at 1030 cm⁻¹. However, our additional Ti-free experiment at 16 GPa, 1200 °C clearly revealed that Na-bearing majoritic garnet has a significant shoulder at 800 - 900 cm⁻¹.

References

- GASPARIK, T. (1989): Contributions to Mineralogy and Petrology, 102, 389-405.
GILLET, P., SAUTTER, V., HARRIS, J., REYNARD, B., HARTE, B. & KUNZ, M. (2002): Am. Min., 87, 312-317
MOORE, R.O. & GURNEY, J.J. (1985): Nature, 318, 553-555.
OKAMOTO, K. & MARUYAMA, S. (2004): PEPI, 146, 283-296.
RINGWOOD, A.E. & LOVERING, J.F. (1970): EPSL, 7, 371-375
RINGWOOD, A.E. & MAJOR, A. (1971): EPSL, 12, 411-418.
SOBOLEV, N.V. & LABRENTAV, J. (1971): Contributions to Mineralogy and Petrology, 31, 1.